

Technology for

Alaskan Transportation

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Alaska Transportation Technology
Transfer Program

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Load Limits on Alaskan Highways

Springtime is load limit time, when roads—whether asphalt or gravel—just can't carry normal loads and survive intact. Alaska's transportation officials won't allow truckers to carry full payloads of goods over the road system.

Why? Melting snow and ice saturate and soften the ground. A heavily loaded truck rolling over the surface causes it to flex—but flexing wasn't in the design. Flexing begets cracking and potholes, the bane of M&O, drivers, and our state budget. Until researchers come up with the perfect surface material, there will be

springtime load limits and/or speed reductions to save the roads.

Legally, all vehicles are subject to load limits. Practically, though, only those that weigh 10,000 pounds or more without a load are restricted. This discrimination has an engineering logic to it. Loads less than 10,000 pounds don't normally do significant damage, but the potential goes up quickly from there. A 40,000 pound load on a two-axle group has a "damage factor" of 1.4. But increase the load to 50,000 pounds—an additional 25 percent—and the damage

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Alaskans Devising Bridge Scour Alarm

Researchers Robert Carlson and Gerald Walker, University of Alaska Fairbanks School of Engineering faculty, are tackling the problem of undetected bridge pier and abutment scour. During construction, bridge supports are buried in the river bed. Severe floods can erode the gravel from around and under them. When that happens, the foundation pads shift, and the bridge can go down. Schoharie, New York suffered the tragedy of lives lost in a bridge collapse. To avoid similar failures, the Federal Highway Administration now requires every state highway department to check for scour at all bridge sites.

Some states have sent down diving teams, but that can be done only after flood waters have passed, and it would always be a major challenge in

a large, silty river like the Big Su (a glacier-spawned river north of Anchorage). Real time warnings are needed, and Dr. Carlson (civil engineer and hydrologist) and Dr. Walker (electrical engineer) are combining their water and radio expertise to develop just that.

The engineering prototype, or demonstration unit, that they're developing is a small "black box" that can be permanently installed on a bridge and left unattended. By measuring signals from buried transmitters, it will continuously determine if there is scour deep enough to cause concern. If that happens, it triggers an alarm. Repairs can be done before damage occurs.

The Alaska Science and Technology Foundation (ASTF) is financing

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ALASKA TRANSPORTATION
TECHNOLOGY TRANSFER

This newsletter is funded by a grant from
the Federal Highway Administration
and the Alaska Department of
Transportation and Public Facilities.

Load Limits on Alaskan Highways (continued from page 2)

factor jumps to 5, an increase of more than 350%! The 50,000 pound load would be just fine on a 3-axle wheel group, though.

Measurement is based on axle weight, which is the weight transmitted to the ground by an axle or a set of axles. (Load reductions do not apply to steering axles. Too much weight there causes hard steering but too little can cause poor traction, which can be dangerous in poor weather.)

Weight reductions have a big impact on the amount of load that a trucker can carry. Generally, at a 75% limit, a truck could carry about half a normal load, and at 50%, it would be nearly empty. For example, a tractor with a flatbed trailer for hauling pipe to Prudhoe Bay might have a steering axle, 3 axles on the drivers, and 3 more on the trailer. For our example, the steering axle will carry 12,500 pounds and each group of 3 axles, 42,000 pounds. During 75% load



Supt. Sonja McManus at the Fox Weigh

limits, that truck can carry the 12,500 pounds on the steering axle but only 75% of the original load, or 31,500 pounds on each group of three. If the thaw season is really wet and the road foundations especially soft, a 50%

limit could be enforced. The steering axle could still carry 12,500 pounds, but each group of 3 axles would be limited to 21,000 pounds. Since the weight of the truck is fixed, all this reduction comes out of the payload.

Local delivery trucks are also affected. A 2,000-gallon water delivery tanker is allowed to carry 1,000 gallons at 75% restriction but only 500 gallons if it has to travel a 50% restriction road.

There are three players involved with load limits: Department of Transportation and Public Facilities (DOT&PF) engineers decide what the limits are and when they're applied, Alaska State Troopers help with enforcement, and Weights and Measures people issue permits, operate the weigh stations and cite violators.

DOT&PF engineers start the process by checking roads for signs of thawing. Temperature probes buried under a few selected sites give more exact feedback. The inspection information is entered into a history that DOT&PF maintains. This history (the

(continued on page 3)

News & Views

Letter to the Editor

469 NRA Lane
Fairbanks, AK 99709

Dear Editor:

In response to your article on "Highway Sign Vandalism", I assert that you have given the "hunter" a bad rap. Hunting season in Alaska runs year around for some species and is months long for others. To say that "Gunfire...peaks in hunting season..." is to blame the hunter without evidence to support the claim. You have presented NO evidence to show that the "hunters" are to blame for the majority of highway sign vandalisms.

To correct your figures, Alaska does not have a "high percentage of hunters." Approximately 16 percent of Alaskans hold hunting licenses, which is low when compared to the percent of households that have guns (50 to 80 percent nationwide depending on whose statistics you use). When over 50 percent of all households have guns, for you to lay major blame on the small percentage

of us who choose to hunt is unwarranted and cannot be supported by evidence.

However, you did ask for solutions to the general problem, and I herewith offer one which has been successful. Simply provide the gun owner with a place to shoot. Now, wasn't that easy? It worked in the Fairbanks area on the Chena River Recreation Area (CRRA). When signs were being shot up, the first response by the governing agency was to put up a sign prohibiting shooting in the area. That sign, predictably, was quickly shot to pieces. After consultations with gun owners, the agency found a better solution. They provided an unsupervised, safe shooting area within the CRRA. The sign now says that there is a shooting range at mile so and so. Vandalism dropped and most, if not all, incidental shooting now takes place at the shooting area. It takes far less time and expense to periodically clean up litter at a range than it does to replace signs. And, the local

sportsmen are willing to take on this clean-up activity anytime they are asked.

There are currently many unused borrow pits along all highways where safe, unsupervised shooting areas could be established with little effort and little or no expense. All it requires is a designation of the firing line by shooting benches or signs or other means and an obvious designation of the target area by the backstop.

Instead of the current signs saying "no shooting" in these borrow pits, there should be signs saying, "welcome, do your shooting here please, instead of along the road." There should be shooting areas along all roads and around all areas of population concentrations.

Shooting is a normal form of recreation for Alaskans. We should provide places to shoot safely rather than try to reduce or eliminate shooting. And, those few of us who hunt need places to sight our guns, practice with them, and to train youngsters. We will appreciate your help.

Sincerely suggested by Joe Nava,
Member
National Rifle Association
Board of Directors ♦

Load Limits on Alaskan Highways (continued from page 2)

accumulated years of experience for that particular stretch) determines the percent load that can be permitted.

Each day the restrictions are imposed means dollars directly out of pocket for commercial truckers, so DOT&PF walks a fine line between protecting the resource and supporting the user. DOT&PF engineers often use a machine called a falling weight deflectometer to "thump" roads, to see how they respond to a load. The readout determines more definitely when the subsurface has firmed enough to lift limits and let the full loads roll.

During full-load season, drivers who have too much weight on any axle may shift the load to "get legal" without being cited. During load-limit time, though, the Weights and Measures scales staff weigh each truck "as found" and write tickets for overweight loads before drivers are allowed to shift things. (The scale staff are specially commissioned officers just for this enforcement purpose.)

Troopers rarely enter the picture; usually they just check permits when a driver is pulled over for some other offense. They don't have mobile scales like some other states do. Most of Alaska's long-haul traffic travels highways with weigh station checkpoints, and there's good communication among the Valdez, Anchorage, and Fairbanks Weights and Measures staff. So, even though very few of the stations are open continuously, the network is tight enough that most loads on our highways are monitored, and weigh station staff can usually handle enforcement. Troopers aren't often involved with load violations.

The day may come when load restrictions don't arrive with the puddles and crocuses, but Alaska is both wet and seasonally cold, a tough combination for road maintenance. Research that leads to improved design standards and to development of new materials and construction techniques keeps cutting down the miles affected and the time that the limits are imposed. This is an area where the work of scientists and engineers has a noticeable impact on both pocketbook and quality of life.

Written with help from DOT&PF Maintenance, Alaska State Weights and

Ten Commandments

1. Thou shalt keep thy shop neat and clean with tools in place and oil spills cleaned up lest thou slip and fall, banging thy head or slipping thy disc.
2. Thou shalt wear eye protection when welding, chipping, sanding, or grinding, otherwise thou may become a lifelong companion to a seeing-eye dog.
3. Thou shalt block up trucks being serviced, but do not trust jacks and hoists because their failure could crush thee.
4. Thou shalt not use thy leg as a sawhorse for power tools lest thou become a one-legged man.
5. Thou shalt lay thy butane lighter far aside when welding. It hath equivalency to a stick of dynamite and could blow thee to thy eternal reward.
6. Thou shalt not use thy file as a pry, thy pliers as a wrench, or thy knife as a punch, lest thou skin thy knuckles and take the name of the Lord in vain.
7. Thou shalt discard thy broken and badly worn tools because they will lead thee to disaster and bloodshed.
8. Thou shalt inflate tires in a cage, lest the ring fly off to behead thee.
9. Thou shalt keep fire extinguishers in operating condition and never use gasoline as a cleaning agent, lest thee exit through the roof.
10. Thou shalt match thy tool to the job and thou shalt watch out for thy fellow workers. Be thy brother's keeper in the shop.

From the Interchange, Fall 1990. ♦

Measures (special thanks to Sonja McManus) and Alaska State Troopers. ♦

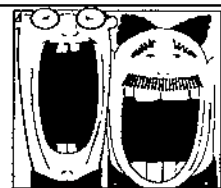
Alaskans Devising Bridge Scour Alarm (continued from page 1)

this experimental program. Using the marketing plan that's part of all ASTF projects, Carlson and Walker will decide whether the package can and should be patented. Since river scour isn't the only use for this kind of

telemetric sensor package, this project may be the beginnings of a homegrown industry with the potential for a worldwide clientele! ♦

*News?! Give us
a call at:*

907/474-2484.



The Alaska Transportation Technology Transfer (T2) Program is a cooperative effort between the Alaska Department of Transportation and Public Facilities (DOT&PF) and the University of Alaska Fairbanks (UAF) Institute of Northern Engineering. This program is funded by the Federal Highway Administration and the Alaska DOT&PF.

T2 program staff:

- * Sharon McLeod-Everette, SR/WA, Director
- * Larry Johnson, UAF Program Manager
- * Susan Earp, Acting Training Coordinator/Technical Libraries

- * Charlotte Barker, Newsletter Editor

T2 Program Advisory Board:

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- * Richard Bonwell, Fairbanks North Star Borough
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- * Dean Nordenson, Juneau City and Borough Public Works
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- * Federal Highway Administration Representative
- * TSgt. David Luera, Eielson AFB, alternate

Technology for Alaskan Transportation is a quarterly newsletter that informs local transportation workers in government and industry of useful training materials and services. If you would like to receive our newsletter, use any of our services, or contribute to the newsletter, contact:

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ALASKA TRANSIT CONFERENCE

(ed. note: by the time this newsletter is published, the Alaska Transit Conference will already have occurred. We hope it was a successful and productive meeting.)

The Alaska Department of Transportation and Public Facilities and the Alaska Transit Association are sponsoring an Alaska Transit Conference. This Conference is scheduled for April 11, and 12 in Anchorage.

Ms. Shelly Brown, Urban Mass Transportation Administration Legal Council, will be the keynote speaker. Her topic will be the American with Disabilities Act. This act will have a major impact on transit in Alaska.

There will be a discussion of all major grant programs associated with transit and workshops on Section 16(b)(2) grants, Section 18 grants, the Commercial Drivers License requirements, and Drug Testing. Passenger Assistance Techniques will be offered the day proceeding the conference.

Scholarships to cover travel costs are available on a limited basis to both public transit companies and private nonprofit organizations.

TENTATIVE AGENDA ALASKA TRANSIT CONFERENCE

WEDNESDAY, APRIL 10, 1991

8:30 am to 4:30 pm PAT Training

THURSDAY, APRIL 11, 1991

8:30 am to 9:00 pm Registration

9:00 am to 9:15 am Introduction

9:15 am to 11:30 am Americans with Disabilities Act (ADA)

Speaker: Ms. Shelly Brown, UMTA Legal Council

11:30 am to 1:00 pm Lunch

1:00 pm to 1:10 pm Introduce Panel. Overview of major grant programs. UMTA Section 16(b)(2), and Section 18.

Speaker: Mr. Bruce E. Wells, State Transit Coordinator.

1:10 pm to 1:25 pm UMTA Section 3 Grant
Speaker: Mr. Tom Briggam

1:25 pm to 1:35 pm UMTA Section 8 Grant
Speaker: Mr. John Kern, Capital Transit

1:35 pm to 1:50 pm UMTA Section 9
Speaker: Mr. Harry Linskens, People Mover

1:50 pm to 2:00 pm UMTA Section 10
Speaker: Cathy Silins, WASH DOT

2:00 pm to 2:15 pm FAUS

Speaker: To be announced.

2:15 pm 2:30 pm OATS

Speaker: Howard DeVore, Older Alaskans Commission

2:30 pm to 3:15 pm Tour of Anchorage Transit Facilities

3:15 pm to 4:15 pm Commercial Drivers License (CDL)

Speaker: Mr. Earl Boucher

4:15 pm to 5:00 pm Alaska Transit Association

Speakers: Max Lyon Jr. - President and Ron Naison - Vice President

FRIDAY, APRIL 12, 1991

8:00 am to 9:00 am Section 16(b)(2) Workshop
Speaker: Mr. Bruce E. Wells

9:00 am to 10:00 am Section 18 Workshop
Speaker: Mr. Bruce E. Wells

10:00 am to 10:15 am Break

10:15 am to 11:30 am RTAP
Speaker: Mr. Bruce E. Wells

11:30 am to 1:00 pm Lunch break

1:00 pm to 4:30 pm Drug-Free Workplace Requirements

Urban Mass Transportation Administration

UMTA RTAP Notes

UMTA GRANT PROGRAMS:

Section 3: Discretionary Capital Grants and Loans

By statute, 80% of this program is earmarked for financing rail modernization and fixed guideway activities. Another 10% is available for the replacement, rehabilitation and purchase of buses and related equipment and the construction of bus-related facilities. Many of the remaining Section 3 funds have been incorporated into various special UMTA programs, such as the Alternative Fuels Initiative (capital assistance for the acquisition of vehicles using alternative fuels), Entrepreneurial Service Challenge Grants (seed money for the entry of private sector operators into public transit programs to improve suburban public transportation). All Section 3 grants carry a 25% non-federal match requirement, but UMTA gives preference to proposals that include a higher local match. Application for Section 3 grants (including UMTA's special initiatives is made through regional UMTA offices.

Funding, 1991: Total Section 3 funding is \$1,115 million. Capital Transit-Juneau, and Barrow are presently requesting funds.

Speaker: Mr. Tom Briggam, Transport/Pacific Associates, will address the application process. Unlike the other UMTA grants listed, there are no official circulars or guidelines on this process.

Section 8: Planning and Technical Studies

The Section 8 Planning and Technical Studies Program provides financial assistance to state and local governments to conduct planning activities for mass transportation. These funds are awarded to state transportation departments and local metropolitan planning organizations on a discretionary basis, with a 20% non-federal match requirement. Planning activities for rural and small urban areas are carried out by state transportation departments, which generally receive approximately 10% of the total Section funding.

Funding, 1991: Total Section 8 funding is \$45 million. Alaska may receive approximately \$20,000 a year.

Speaker: Mr. John Kern, Transit Manager for Juneau Capital Transit, will give an overview of the grant, and discuss the types of planning Juneau has received funding for.

Section 9: Formula Grant Program for Urban Areas

Section 9 funds are available to urban areas for planning, capital and operating assistance purposes. For urban areas of under 200,000 population, the governor or the governor's designee is the recipient of Section 9(a)(1) funds. These formula funds are apportioned on the basis

of population and population density for urban areas under 200,000. Urban areas of population 200,000 or greater receive formula funding directly from UMTA under Section 9(a)(2).

Assistance: The federal dollars may fund up to 80% for planning and/or capital assistance. The federal match for operating assistance cannot exceed 50%. Each urban area has an annually adjusted ceiling on the amount of federal operating assistance it can receive.

Local match must be provided in cash from non-federal funds or from non-farebox revenues such as advertising, concessions and most contract revenues.

Funding, 1991: For urban areas 50,000 - 200,000 in population. Total funding for all states is \$160 million. Alaska receives \$850,300.

Speaker: Harry Linskens, People Mover, Anchorage.

Section 10: Training Programs

Under this discretionary program, UMTA funds training activities at the state, local government and single agency level. Historically, Section 10 funds have been used to finance training program within individual larger transit systems, but they may be used for statewide training activities. Application is made through UMTA headquarters in Washington, D.C.

Funding, 1991: Total Section 10 funding is \$500,000.

Section 16(b)(2): Capital Assistance Program for Nonprofit Agencies Transporting the Elderly and Handicapped

Section 16(b)(2) provides capital funds to private nonprofit organizations for meeting the special transportation needs of the elderly and handicapped in urban, small urban and rural areas. Funds for this purpose are allocated to states, commonwealths and territories on the basis of their elderly and handicapped populations.

Assistance: Private nonprofit organizations are eligible for Section 16(b)(2) funds for capital expenses. These funds are used in large part for the purchase or lease of vehicles, but lifts, radios or other capital equipment necessary for the transportation of the elderly and handicapped by private nonprofit agencies may also be eligible for Section 16(b)(2) funding.

The federal share of eligible capital costs may not exceed 80%; the local share must be at least 20%.

Funding, 1991: Total funding for all states is \$35 million. Alaska will receive \$139,000.

Speaker: Mr. Bruce E. Wells, State Transit Coordinator, will lead a discussion on the program with a review of the States Draft Section 16(b)(2) Management Plan.

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For More Information

For back issues of our UMTA RTAP notes, or to get on our mailing list, write: Publications, Transportation Technology Transfer Program, University of Alaska Fairbanks, 233 Duckering Building, Fairbanks, Alaska 99775-0660. For further information contact (907) 474-2475.

TRANSIT PROFILE

Mr. Bruce E. Wells

State Transit Coordinator

Mr. Bruce E. Wells is the Department of Transportation and Public Facilities' (DOT&PF) State Transit Coordinator at the Headquarters office in Juneau. A graduate of Humboldt State University, he joined the former Alaska Department of Highways in an environmental position in 1975, and became the State Environmental Policy Coordinator in 1987. In 1988, coordination of UMTA grants was added to his environmental duties. He joined DOT&PF's Plans, Programs, and Budget Division as the State Transit Coordinator in June, 1990.

Mr. Wells was a keynote speaker at the Washington State Department of Transportation annual conference in 1989, and is presently organizing the Alaska Transit Conference scheduled in Anchorage on April 11 and 12, 1991. He obtained funding to offer every transit system in Alaska the opportunity to send employees to national transit conferences, and introduced Passenger Assistance Techniques training.

Mr. Wells, who arrived in Alaska by ferry during the winter of 1975, is the father of four children. He is the President of REACH, the largest nonprofit organization in Southeast Alaska that works with the disabled, and serves as a ski instructor for the handicapped. In his spare time he enjoys barbershop singing, and holds the position of secretary of the "Miner Tones", a barbershop chorus.

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Section 18: Formula Grant Program for Non-Urban Areas

Section 18 is a formula grant transportation program for non-urban areas of less than 50,000 population. The purpose of the Section 18 program is to assist transportation agencies serving the general public. Specialized transportation systems also can receive assistance if they open their doors to the general public. Nearly 1,200 local systems, almost 40% of which are private nonprofit agencies, currently benefit from this assistance.

Eligibility: Section 18 funds are available for planning, capital, operating and administrative assistance to state agencies, local public bodies, nonprofit organizations, Indian tribes and groups, and operators of public transportation services. While the funds are for areas of less than 50,000 population, they may include the transportation of non-urban residents to and from urban areas.

Assistance: Local systems may receive up to 50% of their net operating deficit. For capital costs, transit systems may receive up to 80% federal share.

T2 SAYS "FAREWELL" TO UMTA!

The Alaska Transportation Technology Transfer (T2) Program will no longer handle the Urban Mass Transportation Administration (UMTA) Rural Technical Assistance Program (RTAP).

Mr. Bruce Wells (see Transit Profile), State Transit coordinator of Department of Transportation and Public Facilities' headquarters office in Juneau, is assuming full responsibility for the UMTA RTAP. He can be reached at (907)465-2171, or in writing at DOT&PF, Plans, Programs and Budget, P.O. Box Z, Juneau, Alaska, 99811. Mr. Wells, Alaska's expert on transit-related issues, welcomes questions and inquiries.

While this issue of Technology for Alaskan Transportation is carrying its last UMTA insert, occasional transit related articles and information may be published in the future. The T2 library video and publications transit listings will remain available for loan, but new materials won't be added.

It's been our pleasure to manage the two transportation-oriented RTAP for a time (T2 is part of the Federal Highway Administration's Rural Technical Assistance Program, and is also



Funding, 1991: Total funding for all states is \$68.5 million. Alaska receives \$178,100.

Speaker: Mr. Bruce E. Wells, State Transit Coordinator, will lead a discussion on the program with a review of the States Draft Section 16(b)(2) Management Plan.

Section 18(h): Rural Transit Assistance Program

RTAP is a program of training, technical assistance, research and other support services for non-urbanized transit under 50,000 population. RTAP is made up of two components: state programs and a national program.

State programs provide training and technical assistance in conjunction with Section 18 formula assistance program. The national program provides a clearinghouse of information and other materials for use by local operators and state administering agencies.

Assistance: State programs receive 85% of the annual RTAP funding, with the remaining 15% used for the national program.

State agencies apply for Section 18 funding within the same grant application that they use to apply for Section 18

Urban Mass Transportation Administration

UMTA RTAP Notes

funding. There is no federal requirement for a local match for the RTAP funds. Eligible activities include training, technical assistance, research and related support services.

Funding, 1991: Total funding for the states and the national program is \$5 million. Alaska will receive \$54,300.

Speaker: Mr. Bruce E. Wells, State Transit Coordinator

STATE GRANT PROGRAM

OATS

OATS stands for Older Alaskans Transportation Service. OATS refers specifically to the transportation service provided under an Older Alaska Commission grant to the Anchorage-based Salvation Army Older Alaskans Program. OATS refers to a set of basic transportation policies developed by an informal coalition known as the OATS Advisory Committee which is composed of agency directors and client (senior citizens) representatives.

Speaker: Mr. Howard DeVore, Associate Coordinator of the Older Alaskans Commission.

AMERICANS WITH DISABILITIES ACT

The Americans with Disabilities Act (ADA) is a far-reaching civil rights act that may change transportation as we know it today. In passing the act, Congress stated that 43 million Americans had disabilities. They went on to state that people with disabilities had no legal recourse to redress discrimination due to their disability, and that this act was intended to eliminate this type of discrimination.

Speaker: Ms. Shelly Brown, legal council for UMTA, Region 10 will discuss the draft Federal regulations required under this act.

COMMERCIAL DRIVERS LICENSE

During 1991, transit drivers will need to acquire a commercial drivers license (CDL). The Commercial Motor Vehicle Safety Act of 1986 was designed to remove unqualified drivers from the nation's highways. States are required to implement a CDL Program that meets US Department of Transportation standards, and all commercial drivers must be tested and licensed by April 1, 1992.

Anyone who drives a vehicle that weighs more than 26,000 pounds, or carries 15 or more passengers, including the driver, must have a CDL. To obtain a CDL, the driver must score 80% or better on a knowledge test, pre-trip inspection test, and road test. Drivers testing in certain areas of Alaska are exempt.

Speaker: Mr. Earl Boucher, Division of Motor Vehicles, is scheduled to conduct this session.

DRUG TESTING REQUIREMENTS

Implementation of the UMTA-proposed anti-drug program may involve the modification of existing substance abuse policies and programs, or in some cases the development of entirely new programs. The critical program element will be drug testing of employees and applicants for employment in positions which require performance of sensitive safety functions.

This workshop will focus on the status of the regulations, existing requirements for maintaining a "Drug-free Workplace", and the regulations as proposed.

Speakers: Ms. Cathy Silins, Washington State Department of Transportation, will conduct this workshop. Ms. Silins has been involved with the production of several UMTA-funded videos on this subject.

Mr. Gary Taylor, People Mover, will discuss how the Anchorage People Mover's drug program will work.

FEDERAL AID URBAN SYSTEM (FAUS)

This program authorizes State and local officials to fund transit projects with urban system highway funds. These projects are funded from the Highway Trust Fund and are available to all urban areas with a population over 5,000. All projects must be certified by the State as having priority within the overall urban transportation plan.

Speaker: Harry Linskens, People Mover

For More Information

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A NIGHTMARE COME TRUE

by Billy Connor

A few weeks ago, a graduate student came into my office with a floppy disk that contained two years of research data. With an apprehensive look on his face, he said that his computer couldn't read the disk. Unfortunately, he hadn't made a backup of the disk!

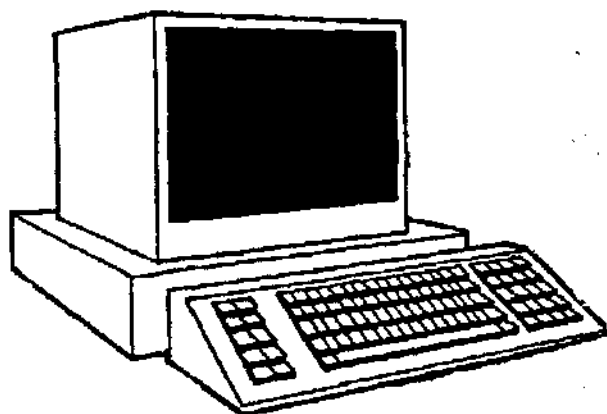
Twenty-four months of work was gone — all because his original disk had gone bad and he had no copy.

While nightmares like this are common, they should never happen if you follow the first law of data storage: **BACK UP YOUR FILES REGULARLY**. However, if you end up in a similar situation, there is often hope if you take the right steps.

First, make a backup copy of the floppy before you do anything else. If you are using the A: drive, type: `DISKCOPY A:A:`. (Note: `_` designates a space in type written commands.) Then insert the original disk and swap to the backup disk when instructed.

Put the **ORIGINAL** disk in a safe place. Do not try to perform any recovery task on the original.

Second, use a data recovery program to recover your data. The most popular programs include PCTools Diskfix, Mace Utilities, and Norton Utilities. Carefully follow the instructions with these programs and you may be able to recover all (or at least part) of the data. Your success will depend upon the cause of the data loss.



A FIRST AID DISK

PC COMPUTING MAGAZINE has a good idea that you will find useful. Sooner or later, you'll have a problem with your hard drive. When you do, you'll need to boot your computer to determine if the problem can be corrected at home or if you should send the computer to the shop.

The solution is simple. Keep a First Aid disk with each computer. To create a First Aid disk, format the disk by placing a new disk in the A: drive and type `FORMAT/S`. Be sure to use the A: drive since the computer will look to this drive first for the system program. Now create the simplest `autoexec.bat` and `config.sys` files necessary to make your computer work properly. In many cases, you won't need either of these files. Now copy any small ASCII editor onto the disk. I suggest you also place a copy of `COMMAND.COM` onto the disk. Copy any other programs which will help correct problems.

If you have Norton Utilities, Mace Utilities, or PCTools, you will want to have working copies of these close by. If you have licensed copies for your computer, you may want to copy a couple of the appropriate files to your First Aid disk. If you're in doubt about which files to include, find a knowledgeable friend.

KEEPING A CLEAN, EFFICIENT HARD DRIVE OR DISK

This would be a good time to review previous issues of **FRIED DRIVES AND SCRAMBLED DISKS (FD&SD)**. Following the ideas in those articles will help keep your drive working at peak efficiency. However, there are several other things you can do to maximize the efficiency of your drive.

ELIMINATE ALL UNNECESSARY FILES

Don't try to keep everything on your hard drive. Take time to remove all `*.bak` files which are automatically created by many programs.

Alaskan Transportation Technology Transfer Program

Computer Notes

If there are files which you rarely use, archive them by using the DOS BACKUP program or one of the many available archiving programs.

My favorite is the shareware program PKARC, which is available on many bulletin board services. Or, you may wish to use the BACKUP command available in DOS.

ELIMINATE ALL UNATTACHED CLUSTERS

If you write and erase a large number of files, DOS has a bad habit of losing track of clusters (see Number 11 of FD&SD for a discussion of clusters.) The File Allocation Table (FAT) shows clusters allocated, but does not know what file they belong to. The best approach is to type CHKDSK_/F at the DOS prompt. The unattached clusters will then be converted to one or more files with the extension .chk. Use an ASCII editor to review the file. If the file contains unneeded data, simply erase the file. If the files contain important information, you probably should get help unless you are thoroughly familiar with DOS.

USE A DEFRAGMENTING PROGRAM REGULARLY

Since DOS uses the first available cluster to write data to a disk, the files can be scattered all over the disk. This causes the disk drive to work hard to read a file. The result is premature failure and slow file access.

By rearranging files on the disk so that the file clusters are sequential, you can increase the life of your disk drive and improve performance. Several programs exist for this purpose including Disk Optimizer, Norton Utilities, PCTools, and Mace Utilities. Get one of these and use it regularly. It is money well spent.

SUMMARY

If your data is valuable, backup the files regularly. If you don't need the data, erase the file. If you think you want to keep the data, but don't need access to the file in the near term, archive it. These simple rules will help keep your disk orderly.

"The attention span of a computer is only as long as its electrical cord."
- Harvey Hutter & Co, 1981

Previous Fried Drives and Scrambled Disks Issues

Computer Notes #:

1	Traffic Analysis Tools
2	Traffic Control Hardware
3	Deadly and Contagious Computer Virus
4	The McTrans Center
5	The Use and Abuse of Computers
6	Surge Suppressores May Save Data
7	Scrambled Disks and Fried Drives
8	Directories and Subdirectories
9	Batch Files
10	Adding Color To Your File
11	Fried Drives
12	A Nightmare Come True

Title:

Newsletter Issue:

Volume 7 - Spring 1988
Volume 7 - Spring 1988
Volume 10 - Winter 1988
Volume 11 - Spring 1989
Volume 12 - Summer 1989
Volume 13 - Fall 1989
Volume 14 - Winter 1989
Volume 15(1) - Spring 1990
Volume 15(2) - Summer 1990
Volume 15(3) - Fall 1990
Volume 15(4) - Winter 1990
Volume 16 Number 1 - Spring 1991

For More Information

For back issues of our newsletters and notes, or to get on our mailing list, write: Publications, Transportation Technology Transfer Program, University of Alaska Fairbanks, 233 Duckering Building, Fairbanks, AK 99775-0660. For more information, you can also call (907) 474-7733.

Shall we recite the litany of HOW TO PROPERLY REPAIR A POTHOLE? It goes something like:

1. Place traffic control devices.
2. Mark the damaged area; draw a rectangle around it so each side is a minimum of 6 inches beyond any of the damage.
3. Start in the center, dig out the weakened asphalt, keep the sides as vertical as possible. Take the cut down to good material.
4. Level and compact the subbase, add material if necessary. New material should match the old, and it should be moist enough so it forms a tight, compact ball when you squeeze a sample in your hand. If you need to fill more than 6 inches, fill it in two or more layers, compacting each.

5. Apply a tack coat to the vertical surfaces and the bottom of the hole. Too little tack coat results in a weak bond, too much leads to bleeding problems, softening the patch.
6. Place the hot mix material, start at the corners and edges, work to the center. Avoid segregation. If the hole is more

than 6 inches deep, layer the material.

7. Compact each hot mix material layer, start in the corners and along the sides. For small patches, a vibratory plate compactor is excellent; for large patches, a vibratory roller is better and faster. If a hand tamp is all that's available, the layers should be 1.5 inches thick at most. Make 1 or 2 passes without vibration, then 10 to 12 with vibration, until each layer is thoroughly compacted.



"PUFF" Asphalt Maintenance Systems

8. Edge seal the patch with a liquid asphalt, make sure that the surface is clean and dry. Overlap the original asphalt by 6 inches. Blot the entire area with clean, dry sand.

9. Clean the work site and collect the traffic control devices.

Workers' safety clothing for this type of job includes a hard hat,

goggles and dust mask (worn when removing defective materials), gloves with gauntlets, heavy high-top shoes or work boots, a long sleeve shirt to prevent burns by hot materials, and a safety vest.

OR...get your outfit a fire-breathing robotic machine. No kidding. There's an innovative small company in New Mexico that has designed PUFF, a self-contained pothole repair machine. At the suggestion of a U.S. Department of Transportation official, the company has contacted T2 centers about the product, so we're passing their information on to you.

First, to let you know there's validity to the concept, they've sent these testimonials: "The U.S. Department of Transportation, in a reprint of the Technology Sharing Division prepared for the Colorado Department of Highways titled 'Experience with a Mechanized Pavement Patching Machine', stated 'After a period of two years, these patches

were found in good condition. Those patches tacked with the asphalt emulsion were in excellent condition and showed no signs of failure.' The machine was also used to repair potholes on a concrete bridge deck. 'An inspection of these patches three years after placement revealed that they are still in place, well compacted and exhibiting good bonding properties.'

"The city of Albuquerque inspected potholes done by the machine in 1987. The inspection was done in 1989. Mr. Ray Chavez, the pavement engineer, had this to say in a letter to the company: 'We have again inspected the potholes repaired by your company...We are happy to inform you that all potholes repaired are still holding up.'"

The Director of Public Works for the City of Rio Rancho, New Mexico, wrote "...to express my appreciation for a job well done. Your knowledge and unique method of pothole patching is by far head and shoulders above the typical patching procedure. Please feel free to use the City of Rio Rancho for any references you might need."

The machine is fully self-contained, one-person operated, and self-propelled. They maintain that it works even in bad weather and has had no problems regarding pothole repair. Neither extremely hot nor extremely cold days have affected the results of the repair work. It's proven to be very time efficient, capable of repairing a pothole approximately 3 feet by 3 feet in a matter of minutes.

When traveling between work sites, the machine can be driven along the highway, under its own power, at highway speeds. There is no need for special size limitations or speed regulations.

It contains all the components necessary to perform the procedures for your chosen repair technique and for proper heated storage of all materials required for the

repair, as well as storage of the waste materials removed during repairs. It's designed to make pothole repairs in pavement with AC surfaces (both conventional AC pavements and PCC pavements that have been overlaid with AC).

Upon arrival at a work site, the asphalt to be repaired is cleaned of dust and all foreign materials by using forced air, heat, and/or a high velocity vacuum. The problem area is then heated to a temperature sufficient to allow removal of the



"PUFF" in action.

top layer of asphalt, using self-contained propane fired burners. After all loose material has been removed, the area is sprayed with a noncarcinogenic emulsified asphalt (160 degrees F) to provide a pyrochemical bond between the new and existing asphalt. The emulsion is cured using the propane burners. Aggregate asphalt (250 degrees F) is then distributed over the area, raked smooth, and then compacted to at least 95 percent maximum density. The company maintains that the use of heat in their "PUFF" Asphalt Maintenance Systems process allows the new material to

be effectively blended into the existing material, providing the best possible bond. After compaction, the repair area is fog sealed with emulsion, providing a barrier against future moisture penetration.

Worker safety, both job- and traffic-related, has been engineered into the mechanized robot. Safeguards are in place around the operational areas, and traffic control warnings are part of the vehicle. Because lane-closing times are minimized, worker exposure to traffic is reduced.

The company holds that if permanent repairs can be made under emergency time frames (in other words, fast), many of the repeated pothole repairs that we now do can be eliminated. This translates to significant cost savings. The machine is also touted to be rugged and easy to use, requiring neither a big crew, specialized skills, nor lengthy training. It can also be pressed into other duties: paint striping, oil or insecticide spraying, filling sand bags, aqua seeding, or as a wandering weed burner. If you can think of a special niche, their engineers will be willing to personalize your PUFF to fit it.

For more information, write One Man, Inc., 7301 Jefferson NE, Suite A-113, Albuquerque, NM 87109, or call (505)898-1900. They invite your call for a price quote.

Adapted from The Connection, Winter 1990, and from material sent by One Man, Inc.

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Place a check by the videos/publications you wish to receive.

- ___ **Asphalt Emulsions: Spray Application**, ID-144, 20 mins. The Asphalt Institute. Process and procedure for asphalt emulsion spray application.
- ___ **Baystate Roads Drainage Workshop**, ID-149, 260min, Baystate Roads, 1988.
- ___ **Cold Mix Recycling of AC Pavement**, ID-148, 13min, New Mexico DOT.
- ___ **Cold Weather Effects**, ID-150, 22min, Caterpillar, 1975.
- ___ **Commercial Driver License Video Series**, ID-147, PennDOT. Topics include vehicle inspection and safety, operation techniques, transporting passengers and goods, air brakes, and hazardous materials.
 - Part 1, 2A, and 2B: 1hr 20min.
 - Part 2C, 2D, 3, and 4: 1hr 23min
 - Part 5, 6, and 7: 1hr 50min
- ___ **Essentials of an Environmental Site Assessment**, ID-139, 50min, Professional Educations Systems, Inc., 1989. ISBN# 1-55957-066-0.
- ___ **Fit for the Road**, ID-157, 20min, USDOT/FHWA.
- ___ **Front Wheel Brakes: Dispelling the Myth**, ID-151, 8:15min, USDOT/FHWA.
- ___ **Highway Runoff Water Quality**, ID-152, 33:20min, Washington DOT.
- ___ **Motor Grader Operation**, ID-153, 54min, 3 parts, Washington DOT.
- ___ **Mustang Grease and Sludge Jetters**, ID-141, 10-15min, Mustang Units Company, Inc., Eldridge, Iowa, copyright 1989. . Promotional videotape. Promotional brochures available, see publication ID-817.
- ___ **Overflex MS Crack Sealer**, ID-145, 1 hr, The Asphalt Institute.
- ___ **Placing Asphalt Hot Mix**, ID-142, 30min, The Asphalt Institute, The National Asphalt Pavement.
- ___ **Rolling Plant Mix Asphalt Pavement**, ID-143, 30 mins, The Asphalt Institute.
- ___ **Rural Roads: A New Approach**, ID-154, 27min, Montana State Film.
- ___ **The South Dakota Road Profiler**, ID-158, 25min, South Dakota DOT. Measure road profile and rut depth.
- ___ **Technical Advancements For Maintenance Workers: For Maintenance Managers and Work Crews**, ID-140, 14:45min, SHRP, 1989. Contract H-110.
- ___ **Upgrading Gravel Roads**, ID-155, 21min, Montana State Film.
- ___ **Using TRIS**, ID-156, 13min, Northwest T2 Center.
- ___ **Vegetation Control**, ID-146, Part I: 20mins, Part II: 25min, Washington DOT.

VIDEOS PERTAINING TO NEWSLETTER ARTICLES

- ___ **Truck Impacts on Pavements**, ID-78, 37min, FHWA. This video introduces the use of truck data in pavement design and discusses the effect truck traffic has on pavements.

Alaskan Transportation Technology Transfer Program

Notes on Publications and Videos

PUBLICATIONS PERTAINING TO NEWSLETTER

- ___ **Bridge Management Systems, Feasibility of Incremental Benefit-Cost Analysis for Optimal Allocation of Limited Budgets to Maintenance, Rehabilitation, and Replacement of Bridges**, ID-346, FHWA-DP-71-2, February 1988, 203pp.
- ___ **Bridges 86 - Replacing Rural Bridges**, ID-507, Roads and Bridges Magazine, 1985, 3pp.
- ___ **Maintaining Bridges After Inspections**, ID-100, 123pp.
- ___ **Rehabilitation of Existing Bridges Workshop**, ID-129, Course Workbook, FHWA, 1986.
- ___ **Spread Footings for Highway Bridges**, ID-192, FHWA-RD-86-185, 1987, 229pp.
- ___ **Truck/Highway Safety**, ID-512, FHWA, HPNPA, January 89, 4pp.

These videos/publications may be borrowed for two weeks. If you wish to receive a copy of any of the above videos/publications to keep or to see if duplication is possible, please contact *Susan Earp* at the Alaska Transportation Technology Transfer Program at (907)474-2484.

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Room 248 Duckering Building
Fairbanks, AK 99775-0660

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Place a check by the publications you wish to borrow.

- ___ **Asphalt Chip Seals**, ID-665, North Carolina Institute for Transportation Research and Education/RTAP, 99pp. Project 46A, video supplement, refer to video list ID-105.
- ___ **Basic Traffic Control**, ID-663, North Carolina Institute for Transportation Research and Education/RTAP, 5pp. Video supplement, refer to video list ID-104, Project 46A.
- ___ **The Best Defense...Is A Good Road**, ID-667, DOT/FHWA, September 1989, 6pp. Reducing Liability Through Risk Management. Supplemental for videotape ID-110.
- ___ **Better Maintenance: Measuring Quality; Training Personnel; Snow fences and Deicing Chemicals; Planting and Patching**, ID-651, TRB/NRC Transportation Research Record 506, 1974, 94pp.
- ___ **Controlling Skids Passenger Car-Vans Straight Truck Instructor's Guide**, ID-666, T 1307, Supplement for videotape "Controlling Skids, See video ID-106, 10pp.
- ___ **Cost Reduction and Service Improvements from Contracting in Rural, Small Urban and Suburban Areas**, ID-671U, UMTA/PB88-240304, December 1987.
- ___ **Crack Sealing**, ID-662, Video Supplement, refer to video list ID - #104, North Carolina Institute for Transportation Research and Education/RTAP Project 46A, 6pp.
- ___ **Design and Operation of Work Zone Traffic Control: Participant Notebook**, ID-655, USDOT/FHWA/NHI, 1988.
- ___ **Ditch Maintenance**, ID-660, Video Supplement, refer to video list ID - 104, North Carolina Institute for Transportation Research and Education/RTAP Project 46A, 11pp.
- ___ **Environmental and Safety Aspects of the Use of Sulfur in Highway Pavements Volume III: Annotated Bibliography**, ID-658, Texas Transportation Institute, College Station, FHWA, September 1980, PB82-137720, 111pp.
- ___ **Evaluation of Concrete Overlays of Bridge Applications**, ID-657, Washington State DOT, WARD 137.1, Final Report, PB88-180104, October 1987, 73pp.
- ___ **Financing for the Future: Changing Roles in Mass Transit**, ID-673U, USDOT, December 1987, 351pp.
- ___ **Frost protection of road pavements with insulation boards. Norwegian practice and experience**, ID-649, Frost I Jord (Frost Action In Soil), No. 26, pp. 3-10, December 1987, article.
- ___ **Handbook for Purchasing a Small Transit Vehicle**, ID-668U, USDOT-T-89-07, Technology Sharing Program, October 1988, 136pp.
- ___ **Helping Yourself to Microcomputers, Session 1**, ID-672U, Transit Productivity Program, 1983 APTA Annual Meeting, Denver, Colorado, USDOT/UMTA/APTA, 1983, 64pp.
- ___ **Implementation Guidelines for Anti-Drug Programs in Mass Transit**, ID-669U, USDOT/UMTA-IT-06-0190-89-1, Office of Technical Assistance and Safety, March 1989, 188pp.
- ___ **Improving Snow Roads and Airstrips in Antarctica**, ID-656, Special Report 89-22, USACE/CRREL, July 1989, 18pp.
- ___ **Maintenance of Gravel Roads**, ID-659, Video Supplement, refer to video list ID - 104, North Carolina Institute for Transportation Research and Education/RTAP Project 46A, 19pp.

Alaskan Transportation Technology Transfer Program

Notes on Publications and Videos

- ___ **Mass Transit Management: A Handbook for Small Cities**, USDOT, Third Revised Edition, February 1988, Technology Sharing Program.
 ID-679AU ___ Part 1: Goals, Support, and Finance, 78pp.
 ID-679BU ___ Part 2: Management and Control, 78pp.
 ID-679DU ___ Part 4: Marketing, 78pp.
- ___ **National Ridesharing Demonstration Program: "Maxi-Taxi" Services in the Tidewater Region of Virginia**, ID-675U, USDOT/UMTA, July 1985, 150pp.
- ___ **Pothole Patching**, ID-661, Video Supplement, refer to video list ID - #104, North Carolina Institute for Transportation Research and Education/RTAP Project 46A, 8pp.
- ___ **Right-of-Way Forum**, ID-653, Course Notebook, August 7 - 8, 1989, various instructors, 200pp. Costs: \$15.00, Must be paid for in advance.
- ___ **Safety, Loss Control and Risk Management: An Assessment of Practices at 17 U.S. Bus Transit Agencies**, ID-674U, USDOT/UMTA, April 1989, 200pp.
- ___ **Shoulder Maintenance**, ID-664, Video Supplement, refer to video list ID - 105, North Carolina Institute for Transportation Research and Education/RTAP Project 46A, 17pp.
- ___ **Snow Control, Traffic Effects on New Concrete, and Corrosion**, ID-652, TRB/NRC Transportation Research Record 860, 1982, 49pp.
- ___ **Traffic Control Devices Handbook**, ID-670, USDOT/FHWA, 1983.
- ___ **Transit Bus Maintenance Management: Summary Report**, ID-678U, USDOT, Technology Sharing Program, August 1984, 87pp.
- ___ **Urethane Plow Edges**, ID-648, Roads and Bridges, June 1988. Urethane plow edges protect brick streets, smooth operator nerves, protect equipment from damage in downtown Duluth, article.
- ___ **User-Side Subsidies for the Elderly and Handicapped in Lawrence, MA**, ID-676U, USDOT/UMTA, June 1984, 200pp.
- ___ **Work Zone Traffic Control Devices**, ID-650, Used in August Work Zone Traffic Control Seminar given by T2 with Eugene Wilson as instructor from Wyoming's T2 Center. Costs: \$20.00, Must be paid for in advance.
- ___ **Work Zone Traffic Control: Standards and Guidelines**, ID-654, USDOT/FHWA, 1985 Edition (updated), 159pp.

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TECHNOLOGY TRANSFER

1991 T2 CALENDAR OF EVENTS

April 11 - 12: Alaska Transit Conference, Anchorage.
For information contact Mr. Bruce E. Wells at (907) 465-2171.

APRIL						
S	M	T	W	T	F	S
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May 16 - 17: Writing and Editing for Others, Anchorage.
Course fee: \$150. A follow-up to Technical Writing for Transportation Professionals. For information contact Lorrie Trimble at (907) 474-2444.

MAY						
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June 2 - 7: Winter Vehicle Mobility Conference, Santa Barbara, California.
Sponsored by the Engineering Foundation - New York. For further information, contact the Engineering Foundation at (212) 705-7835.

JUNE						
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EXTRA! EXTRA! READ ALL ABOUT IT!

If you would like to be on our mailing list and receive our newsletter, publications and videotape lists, and course flyers, please send your name and address to:

or call Susan Earp at (907) 474-2484.

Alaska Transportation Technology Transfer Program
Room 248 Duckering Building
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Who's Who in Alaska's Transportation Network

In each issue we'll spotlight someone in our transportation system.

Peggy Martin works for 96 mini-DOTs and loves it! As Manager of Rural Services Division (part of the Fairbanks North Star Borough (FNSB) Mayor's Office), she's the functional link between the FNSB and all the road service areas within the Borough.

FNSB doesn't have road powers, but neighborhoods can petition the Borough to establish a service area that can tax itself and receive State funding. Ninety-six have chosen to do that. Each area is governed by a board of commissioners elected from its members.

Can you imagine the challenge of training 350 people in the web of Borough purchasing statutes? This dilemma has been solved by "letting Peggy do it". She and her staff issue purchase orders, write technical specifications for bids, publish requests for quotes, and do all those legally bound actions for the commissioners. In fact, ask her what she likes best about her job and she'll say "working with volunteers" and "cutting through red tape"—like shifting money from where it was to where it had to be so that snow and hardpack removal could continue. In Fairbanks this spring, that's important.



Peggy Martin, FNSB Rural Services

Peggy is also a success story for us. She attended a 1988 T2 workshop on road safety, then went out and beat the bushes for funding to carry out a hazards analysis and education program within the service areas. You may have heard about it when she spoke at the 1990 conference.

If you want to talk with a specialist in road service areas, call Peggy at 452-4761.

TIDBITS

... small pieces of information for you

DID YOU KNOW ...

you need at least 4/32 inch tread depth in every major groove on the front wheels of a commercial vehicle?

From State of Alaska CDL Manual -- Available at your nearest DMB office.



DID YOU KNOW ...

there are three kinds of emergency equipment you must have in a commercial vehicle:

- * fire extinguisher(s),
- * spare electrical fuses (unless equipped with circuit breakers), and
- * warning devices for parked vehicles (for example, three reflective warning triangles).

From State of Alaska CDL Manual -- Available at your nearest DMV office.

How to Get Those Creative Juices Flowing

Ever get stuck on a problem? Just can't figure out a solution? You're not alone. Whether you work in R&D, in management, or in the hands-on environment, progress continuously demands that you look at problems from a different perspective. To get things done, you may have to find or develop solutions that are unconventional or unfamiliar. Sometimes just sleeping on it works. Sometimes you need more than that to get those creative juices flowing.

Here's a checklist of questions designed to spur the process. These questions are generic and can apply to any type of work environment. Try them sometime; you may be surprised.

- ❑ **PUT TO OTHER USES?** New ways to use as is? Other uses if modified?
- ❑ **ADAPT?** What else is like this? What other idea does this suggest? Does the past offer a parallel? What could I copy? Whom could I emulate?
- ❑ **MODIFY?** New twist? Change meaning, color, motion, sound, odor, form, shape? Other changes?
- ❑ **MAGNIFY?** What to add? More time? Greater frequency? Stronger? Higher? Longer? Thicker? Extra value? Plus ingredient? Duplicate? Multiply? Exaggerate?
- ❑ **MINIFY?** What to subtract? Smaller? Condensed? Miniature? Lower? Shorter? Lighter? Omit? Streamline? Split up? Understate?
- ❑ **SUBSTITUTE?** Who else instead? What else instead? Other ingredient? Other material? Other process? Other power? Other place? Other approach? Other tone of voice?
- ❑ **REARRANGE?** Interchange components? Other pattern? Other layout? Other sequence? Transpose cause and effect? Change pace? Change schedule?
- ❑ **REVERSE?** Transpose positive and negative? How about opposites? Turn it backward? Turn it upside down? Reverse roles? Change orientation?
- ❑ **COMBINE?** How about a blend, an alloy, an assortment, an ensemble? Combine units? Combine purposes? Combine appeals? Combine ideas?

Adapted—without mental block—from Transearch, August 1990.